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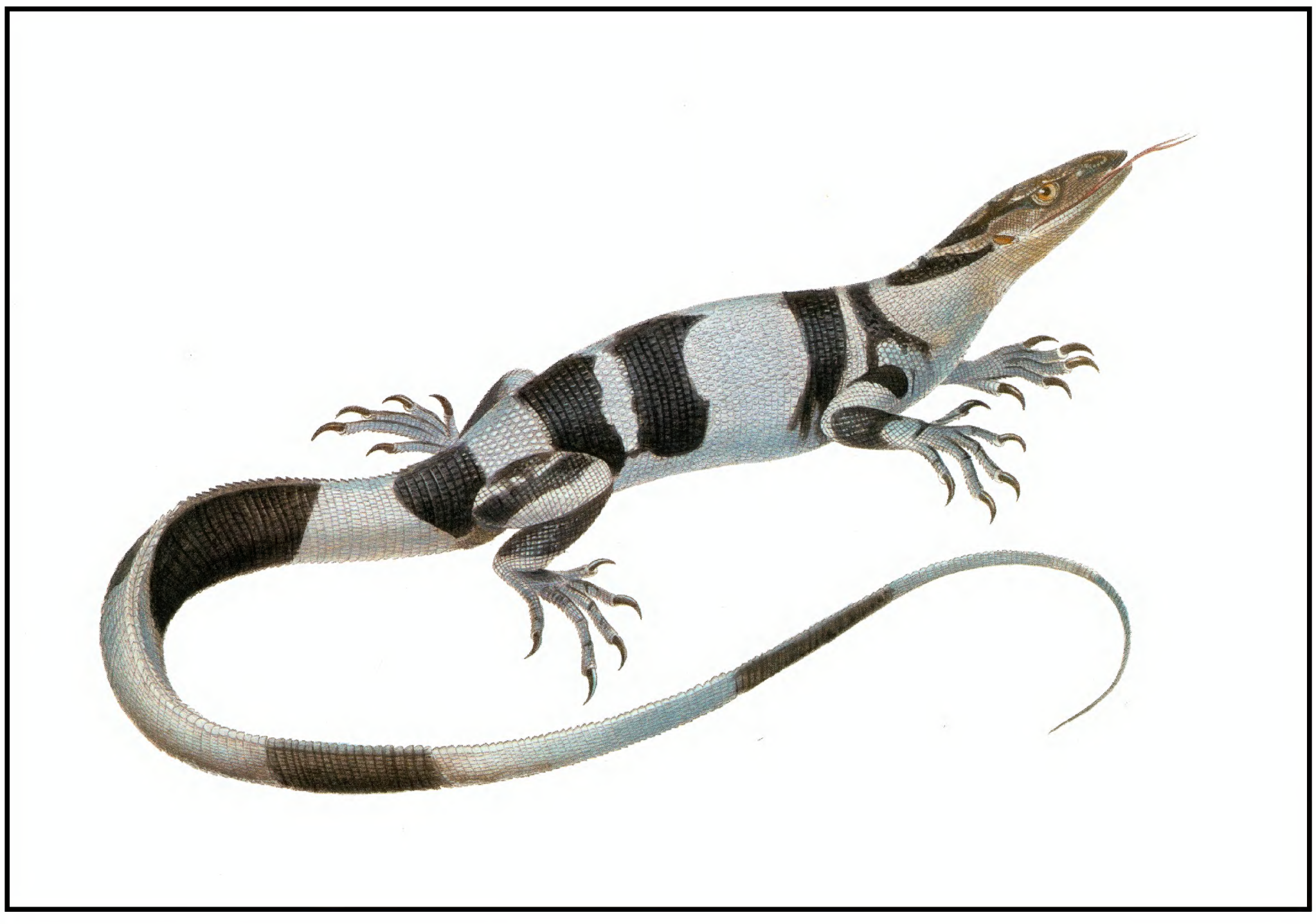

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Notes on Reproduction of Southern Toads, *Anaxyrus terrestris* (Anura: Bufonidae), from Virginia

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Abstract

I conducted a histological examination of gonadal material from 33 adult *Anaxyrus terrestris* consisting of 12 males, 19 females and 2 subadult females from Virginia, USA. The smallest mature males (sperm in lumina of seminiferous tubules) both measured 48 mm SVL and were from May and June, respectively. The smallest mature female (mature oocytes) measured 60 mm SVL and was from July. Varying amounts of follicular atresia (spontaneous degeneration of oocytes) were noted in nine (47%) of the 19 adult females. The ovaries of three females, one each from March, April and June contained postovulatory follicles (evidence of recent spawning activity). *Anaxyrus terrestris* from Virginia is in spawning condition from March (females from earlier months were not examined) into autumn (November).

Anaxyrus terrestris (Bonnaterre, 1789) ranges from south-eastern Virginia and southeastern Louisiana along the coastal plain to Florida (Frost, 2021). *Anaxyrus terrestris* reproduction occurs most frequently from spring to summer (Dodd, 2013). *Anaxyrus terrestris* are active all year, weather permitting, especially in the southern portion of their range; rainfall is not needed to stimulate their activity (Dodd, 2013). Semlitsch et al., (1996) reported a significant positive correlation between the *A. terrestris* breeding population size and rainfall. Breeding occurs in ponds, pools and ditches (Elliott et al., 2009). *Anaxyrus terrestris* prefer sandy soils into which they burrow (Green et al., 2013). Their habitats include pine forests, coastal scrub, forests and open fields (Dorcas and Gibbons, 2008). The biology of *A. terrestris* is summarized in Blem (1979). In this paper I add information on reproduction of *A. terrestris* in Virginia from a histological examination of gonadal tissues. The use of museum collections for obtaining reproductive data avoids euthanizing specimens and obviates the need for a collecting permit from state and federal authorities.

A sample of 33 *A. terrestris* from Virginia collected 1944 to 1990 (Appendix) consisting of 12 adult males (mean SVL = 53.8 mm ± 4.2 SD, range = 48–58 mm), 19 adult females (mean SVL = 71.1 mm ± 7.9 SD, range = 60–90 mm) and two subadult females (SVLs = 50, 53 mm) was examined from the herpetology collection of the Carnegie Museum of Natural History (CM), Pittsburgh, Pennsylvania, USA. An unpaired *t*-test was used to test for differences between adult male and female SVLs (Instat, vers. 3.0b, Graphpad Software, San Diego, CA, USA).

A small incision was made in the lower part of the abdomen and the left testis was removed from males and a piece of the left ovary from females. Gonads were embedded in paraffin, sections were cut at 5 μm and stained with Harris hematoxylin followed by eosin counterstain (Presnell and Schreibman, 1997). Histology slides were deposited at CM.

Testicular morphology of *A. terrestris* is similar to that of other anurans as detailed in Ogielska and Bartmańska (2009a). Within the seminiferous tubules, spermatogenesis occurs in cysts which are closed until the late spermatid stage is reached; cysts then open and differentiating sperm reach the lumina of the seminiferous tubules (Ogielska and Bartmańska, 2009a). A ring of germinal cysts is located on the inner periphery of each seminiferous tubule. All 12 *A. terrestris* males in my sample were undergoing spermiogenesis. By month these were: March (N = 1), April (N = 2), May (N = 2), June (N = 1), July (N = 2), August (N = 1), September (N = 1), October (N = 2). The two smallest mature males measured 48 mm SVL, and were from May (CM 140312) and June (CM 126360), respectively. Wright and Wright (1933) reported adult males of *A. terrestris* measured 42–82 mm.

The mean SVL of *A. terrestris* females was significantly larger than that of males ($t = 7.0$, df = 29, $P < 0.0001$). The ovaries of *A. terrestris* are typical of other anurans in being paired organs lying on the ventral sides of the kidneys. In adults the ovaries are filled with diplotene oocytes in various stages of development (Ogielska and Bartmańska, 2009b). Mature oocytes are filled with yolk droplets; the surrounding layer of follicular cells is thinly stretched. Postovulatory follicles were also noted. These form when the ruptured follicle collapses after ovulation; the follicular lumen disappears and proliferating granulosa cells are surrounded by a fibrous capsule (Redshaw, 1972). Postovulatory follicles are short-lived in most anuran species and are resorbed after a few weeks (Redshaw, 1972).

Monthly stages in the spawning cycle of *A. terrestris* are in Table 1. Two stages were present: (1) "Spawning Condition" in which mature oocytes predominated; (2) "Post-spawning" in

Table 1. Two monthly stages in the spawning cycle of 19 adult female *A. terrestris* from Virginia.

Month	N	Spawning Condition	Post-spawning (postovulatory follicles)
March	3	2	1
April	2	1	1
May	1	1	0
June	3	2	1
July	1	1	0
August	2	2	0
September	3	3	0
October	2	2	0
November	2	2	0

Table 2. Months of breeding by state for *A. terrestris*.

Locality	Breeding Period	Source
Alabama	mid-March to late May	Mount, 1975
Carolinas and Virginia	Late February to May	Beane et al., 2010
Florida	25 March to 5 September	Carr, 1940
Florida	all year in south, February to September in north	Krysko et al., 2019
Georgia	April to August	Wright, 1932
Georgia	February to October?	Jensen et al., 2008
Louisiana	mid February to early August	Boundy and Carr, 2017
North Carolina	February to May, summer?	Dorcas et al., 2007
South Carolina	March, April	Gibbons and Semlitsch, 1991
South Carolina	All year	Semlitsch et al., 1996
Southeast	January to October	Dorcas and Gibbons, 2008
No specific locality	February to May	Elliott et al., 2009

which postovulatory follicles predominated. There were three females in the post-spawning category in Table 1. One female each from March (CM 126106), April (CM 127520) and June (CM 126474) contained postovulatory follicles, evidence of recent spawning (*sensu* Redshaw, 1972). One of them, from June (CM 126474) also contained residual mature oocytes. It is not known if these oocytes would have been spawned later in the year or if they would have been resorbed (undergo atresia). Two females (CM 142343, SVL = 50 mm, from May) and (CM 141309, SVL = 53 mm, from August) contained primordial oocytes and were considered to be subadults. The smallest mature female (mature oocytes) measured 60 mm SVL (CM 126678) and was from July. Wright and Wright (1933) reported adult females of *A. terrestris* measured 44–92 mm.

Atresia, a widespread process occurring in the ovaries of all vertebrates (Uribe Aranzábal, 2009) was also noted in the ovaries of *A. terrestris*. It is common in the amphibian ovary (Saidapur, 1978), and is the spontaneous digestion of a diplotene oocyte by its own hypertrophied and phagocytic granulosa cells which invade the follicle and eventually degenerate after accumulating dark pigment (Ogielska and Bartmańska, 2009b). See Saidapur and Nadkarni (1973) and Ogielska et al. (2010) for a detailed description of stages of atresia in the frog ovary. Atretic follicles were observed in 9/19 (47%) of the adult females in my sample. Atresia plays an important role in fecundity by influencing numbers of ovulated oocytes (Uribe Aranzábal, 2011).

In conclusion, my data confirm *A. terrestris* reproduce from spring to summer as reported by Dodd (2013) and Table 2. It is not known if the late summer–autumn gravid *A. terrestris* females will spawn late in the year or if the eggs will remain over winter to be utilized in spring. Jørgensen et al. (1979) and Jørgensen (1981) reported ovaries in frogs from the temperate zone are close to breeding size by the time of hibernation. Histological examination of samples of *A. terrestris* from additional months are warranted to elucidate all aspects of the reproductive cycle.

Acknowledgment

I thank Jennifer Sheridan (CM) for permission to examine *A. terrestris* and Stevie Kennedy-Gold (CM) for facilitating the loan 2021–07.

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Appendix

Thirty-three *Anaxyrus terrestris* from Virginia (by county) examined from the herpetology collection of the Carnegie Museum of Natural History (CM), Pittsburgh, Pennsylvania USA.

Chesapeake: CM 36037, 126106, 126116, 127195, 129511, **Norfolk:** CM 129180; **Southhampton:** CM 126678; **Suffolk:** CM 126354, 126360, 126474, 127211, 127212, 127220, 127445, 127490, 127508, 127520, 128079, 128105; **Sussex:** CM 129520; **Virginia Beach:** CM 23635, 126344, 128055, 128115, 140311, 140312, 141124, 141309, 141836, 142267, 142292, 142333, 142343.

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A Day in the Life of Radio-tracking with the Peach, or One Thing Leads to Another!

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Several of you who receive the *Bulletin* used to receive emailed "Suizo Reports" from me as well. I dare say that those reports were much more popular than these monthly *Bulletin* columns. That didn't stop me from losing most of them. But I *do* still have a few in my possession, and one of those that I saved is timeless and precious enough to share again. While at first I thought the report was good enough to run here in its original form, I now feel that a few embellishments are required to make a more cohesive and coherent column. Hence, roughly 6,000 words in this column were *not* in the original report. The original Suizo Report was written on 22 March (two days after the day being described). I also have two other sources to guide me: my field journal and my data-sheets. I will quickly mention here that I use the word *atrox* to describe Western Diamond-backed Rattlesnakes (*Crotalus atrox*) throughout. One thing that I *never* explained in the email reports was how the good Dr. Gordon Schuett wound up with the nickname of "the Peach." Truth be told—nobody ever asked! Perhaps they were *afraid* to ask? The few people to whom I eventually explained the origins of the inappropriate moniker seemed disappointed. Maybe they expected something more intimate? Nope! We were both happily married men. (Well, at least *one of us* was!) It has recently been abruptly pointed out to me that I am a dinosaur. If it is *not* PC to mention my being a happily married man, then yes! Will somebody *please* arrange to have a comet fall on me? Anyway, back in 2003, Gordon moved to Georgia to take on a job at Zoo Atlanta as curator of primates. The job did not work out for him, as he found it difficult to engage in the monkey business of zoo politics. When he returned from Georgia to his home in Glendale, Arizona after roughly six months of monkeying around, I began calling him "the Peach." That is only because Georgia is commonly known as the Peach State. Calling him the Peach was my way of kicking him in the nuts for leaving me to tend to our study plot alone.

If some of you newer members to the CHS feel that you have wound up in the middle of something, and understand nothing of this talk of Gordon Schuett, the Peach, the Suizo Mountains, or radio-tracking—you poor things, you have a lot of catching up to do. I will plop a couple of references under the Literature Cited heading below. If I included *all* the articles that referred to the Suizo Mountains or Gordon Schuett that I have written in my Literature Cited section, we would have a minimum of two full pages of self-aggrandization that would include a few books and several chapters in each book. But I've made it easy on both you *and* me by keeping it brief. Feel free to skip all that if you wish, and take this one on the run. In any case, welcome to the CHS!

I will put the original wording of the report in italics, and expand and explain as inspired beneath. We will also use a "Then and Now" approach to help the reader discern which is which. Enough! Let's rock with the Suizo Report that dealt with the adventures of 20 March 2004:

Then:

Jeez, we jumped from winter to summer in less than one week flat. On Saturday, 20 March, we were getting shaded ambient temps of 35 C (95 F). Up on Plymouth Rock, we got a hot spot temp of 52 C—that is 126 degrees F! Ouch.

Now:

No lies were told in that first sentence. Our data from 13 March reveals that both ambient and hot-spot temps reached 20.5°C (68.9°F). On 20 March—7 days later—any one of our subjects could have slipped into a location that was up to 14.5°C (58.1°F) warmer than on 13 March. As part of our study, hot-spot temps were faithfully recorded on unshaded ground, in direct sunlight (if possible), normally within one meter of the subject's location. The logic behind doing that was if the subject wanted to be in the warmest spot possible at that location, there it would be. And sometimes, there it was! But many more times than not, even on cooler days, there it wasn't! While we have never used our *explosive* temperature dataset in any peer reviewed article, much to my initial surprise being an ectotherm does not force our cold-blooded friends to always seek the warmest possible place to roost. Quite the opposite, actually. The main reason that we never did anything with our temperature data is because we didn't wish to knock ourselves out to prove *what*? That ectotherms thermoregulate? Wow—what a gully-washer of a concept—and *so* not worth it! I'm just glad that we had temp-sensitive transmitters inside of our subjects. This eliminated all need to follow the example of lizard people, who go around pronging their hapless subjects with cloacal thermometers to prove *what*? I can visualize the heated conversation between a lizard geek and the hapless lizard that (s)he has just captured. "Hold still—damn you! I must prong you in order to prove that you are thermoregulating." While I am personally a fan of the saying "you can never collect too much data," maybe you can? Do the readers have any idea the risk that we would have taken by stuffing a thermometer where the sun never shines into every indignant rattlesnake that we encountered through the years? I'll give you all a hint: This right-handed herper has been picking his nose with his *left* index finger since 1991 as a result of this anal-probing bullshit. (And despite all of the practice, lefty *still* doesn't get the job done properly.) How many times would we have been bitten if we performed this barbarism more than the 7,500 times that we tracked a rattlesnake down? "Let's see how warm we are today Mr. *Atrox*. Open wide! Ouch—I meant the *other* hole." Hell's bells, we'd *both* be picking our noses with our elbows!

There is also mention made of Plymouth Rock in the early phases of this report. This is not the same Plymouth Rock as in the story of Christopher Columbus and his Pilgrims from Yugoslavia discovering America. Nosiree, our Plymouth Rock had but one "Pilgrim," who was an all-American Gila Monster so named because of his propensity for traveling vast distances just

to annoy us. Moving on with original narrative:

Then:

The Peach and I worked the plot together on Saturday. Enroute in, we captured one atrox for processing. During the early evening ride back home, we got two more (one was DOR).

Now:

Saturday, 20 March, was in the middle of a three-day marathon of a March-madness roundup. Gordon spent Friday and Saturday nights at my house. We rode together to our Suizo Study plot this Saturday morning, picking off the first road *atrox* on the way in. I estimated its size and rattle count for our datasheet (Page 40, first entry: "Estimate: Basal + 9 / 10 Bkn, ~1m S-T, ~450 gram snake"), then just plopped it into a bucket. Said bucket had a screw-on lid, and also had several snake bags inside it. The snake quietly crawled under the loosely-piled cloth sacks, and remained silently coiled under the same. The plan was to thoroughly process him later in the day, and release him on the way home.

When we got to the study plot, we dropped the bucket off at our favored rest spot. The place was called "The Shady Spot" for obvious reasons. We did nothing to identify what was in that bucket externally. At some point between putting the bucket down at the shady spot and lunch time, somebody stole that bucket. We had seen a gray Nissan pickup truck with a cargo rack over the cab in the vicinity during our comings and goings. We assume the lone person driving that rig was our thief.

I never saw that particular truck again. This gives me great hope that our witless thief snatched that bucket, and our quiet *atrox* remained silently coiled on the bottom, under the cloth sacks. If fate and karma smiled upon us, that thieving schmuck stuck his hand inside that bucket, and joined both Gordon and me as a member of the "White Fang Club." And if his initiation killed him, his membership by default would become honorary. We can hope! That was the only time *ever* that something was stolen at our Suizo Mountain Plot, and I have been going out there since 1992!

Then:

Once on the plot, our day started with a bang. We visited AD1, and found a previously marked male atrox prowling the southeast, shaded apron of the den. We determined this to be male atrox #26, who was found and marked on 9/20/02. The sharpie marks on his rattle have held up beautifully, and indicated that he has shed twice over the past 1.5 years.

This is the 13th atrox found at AD1 (10.3). When one considers that we have only processed 62 adult atrox on our plot, it is interesting to note that 21% of these have come from a roughly 3 square meter patch of ground.

Now:

I could easily write a book about "*atrox* den #1," or AD1, but I will keep it short. I first found the den in February of 1999, and watched it for two years prior to the initiation of our study, which occurred in early March of 2001. In going deeper with the original report, all 62 of the *atrox* mentioned—including male #26—were microchipped. It is possible to likely that some of these are still alive today. These survivors would now be well over 20 years old now. Microchips are forever. Some lucky soul could easily be some waves of a reader away from gaining long-term longevity data on a wild population of *atrox*—not to mention three other species of venomous herps. Perhaps a student in need of a project will read these words, and the delicate minefield of grants, Gordon Schuett, and me could be navigated to set up a most interesting longevity study.

AD1 has harbored *atrox* every late fall, winter, and early spring each year since 1999. The last time that I checked the den was 23 March 2021, and it had *atrox* there at that point in time. I will not go back there again until sometime in March of 2022. Even though AD1 had *atrox* available to us throughout the duration of our study, in 2006 we made the conscientious decision to leave the place alone. We had gathered a lot of data from there by 2006, and we saw no need to keep pestering the *atrox* that used the place. The numbers of *atrox* there were in serious decline, and it was time to let the place heal. Nevertheless, I am including two images of AD1 that show a 17-year spread of *atrox* inhabiting this den (Figure 1). The fact that it still has *atrox* using it demonstrates that leaving it alone was a good course to follow.

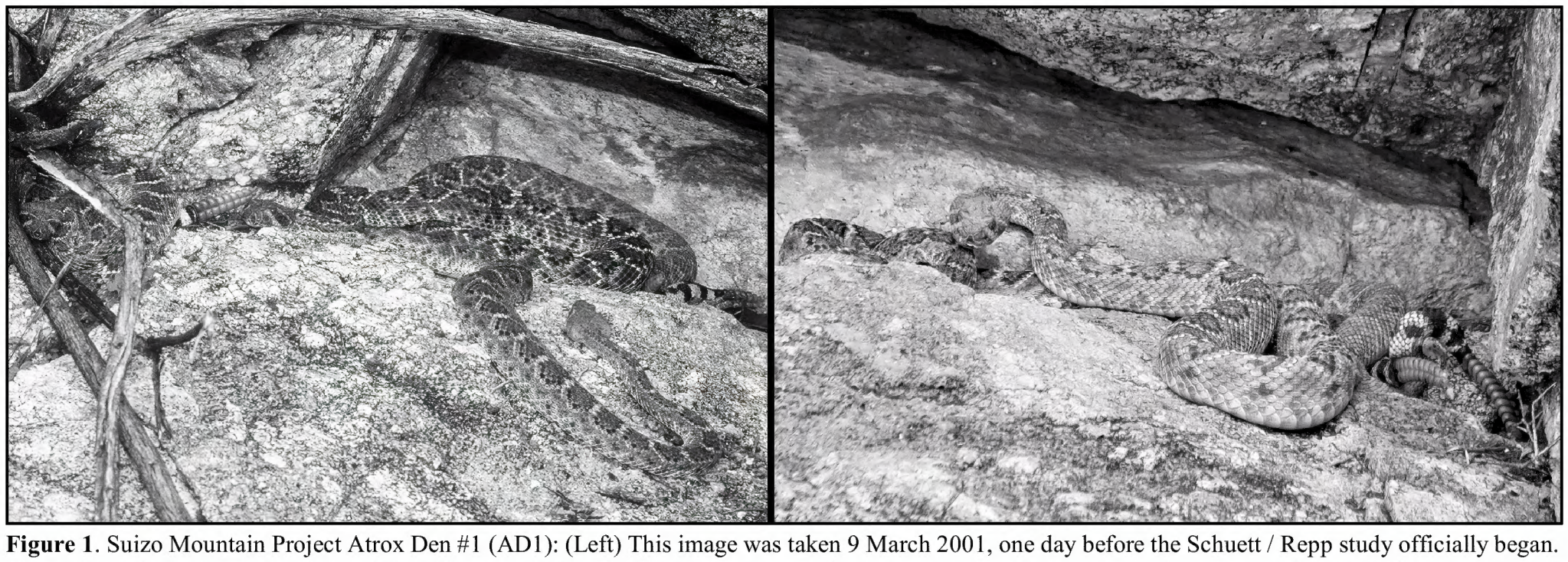

Figure 1. Suizo Mountain Project Atrox Den #1 (AD1): (Left) This image was taken 9 March 2001, one day before the Schuett / Repp study officially began. The snake with the tapered and complete rattle on the left side of this image was without question female #2, who is also shown in Figure 4. (Right) A pair of *atrox* in courtship at AD1 taken 22 March 2018. These two images represent a 17-year spread of *atrox* occupying this den. Unless indicated otherwise, all images are by the author, and all locations are extreme south-central Pinal County, Arizona.

Then:

From AD1, we took the top of the hill to get the signals of all 28 animals. I call the fine art of trying to zero in from afar the accurate locations of each animal "mass signaling." The process is tedious. It requires dialing the signal down in volume until it is but a whisper, and zeroing in on where said whisper becomes the loudest. At one point, the Peach took it upon himself to assist me with my endeavors in pinpointing locations of our animals by making a phone call to his family while standing about ten feet away from me. This irked me slightly, but not enough to say anything. But this wasn't the end of the process known as "annoying the tracker." He next stands beside me, and starts coughing, wheezing, snorting snot, hacking up loobies, blowing his nose, and emitting various other guttural noises too disgusting to elucidate upon herein. This DID get a rise out of me—and pretty much set the tone for the day. It was HOT—and the weather was warm too!

Now:

Cell phones! I *hated* them then, and I *really* hate them now. My mantra, then and now, was when one is in the field, one is no longer part of the rest of humanity. We are in the middle of nowhere. If you are having an emergency, call somebody else. *You* are in the middle of 7 billion people—we are not! There is *nothing* important enough to disturb the harmony of our herping trip, and meanwhile, we are minimally *hours* away from being able to help. But let's not stop with that. Let's continue with this rant. Let's race into the future—closer to the land of now. How about these *idiots* who want to show you their phone images while they are driving on a nocturnal road cruise? Oh yeah! The blazing flash of the *certain* night blindness that accompanies a cell phone image is not at all conducive to road-riding at night. And just as bad are the people who want to bore the piss out of you with their images while the bliss of nature surrounds you. I am in the wild to get away from computers! I once missed seeing a lizard hop on my pantleg, snag a moth, choke it down, and hop back down because some *idiot* had their phone in my face! "Hey Roger," says the person who did *not* have an effing phone stuffed in his face, "did you know that a lizard just picked off a moth from your pant leg?" *I live to see stuff like that*! G-r-r-r!

There was a big old fat lie in the original text above. I wrote that Gordon's phone call home "irked me slightly." It actually pissed me off to Pluto and beyond! My actual words were: "Do you mind?" And when *that* didn't work, the universally-understood phrase of "*Get the eff outta here"* got the job done. And *then*, right after he hangs up, he returns at my side, and begins his snot-a-thon in earnest. What the hell was he thinking? In fact, the words that preceded my all-out tantrum were: "*What the hell are you thinking*?" He finally got the hint, and remained at a respectful distance while being noisily ill.

All of this sort of crap is why I almost always did the mass signaling alone. The process of taking the top of the hill, checking the unique three-digit signal of every study animal we had, and marking each of their locations on a crudely-drawn map of the area was *priceless* in helping us to track as many animals as possible on any given day. Mass-signaling required extreme focus and concentration in order to yield accurate results. The most difficult aspect of the process was trying to fathom whether the animal was on the hill, or down in the flats. If I was not sure of this, we could easily hoof to the top of a hill to track one animal, head to the bottom to get the next, and then have to go to all the way to the top again for the next. I call this sort of up-and-down tracking "Tom Sawyer tracking," as the method is similar to whitewashing a fence. Up you go, down you go—five or six times. If you ever experience the thrill of Tom Sawyer radio-tracking while following someone, know that you are dogging an idiot. Tell that idiot to get his (or her) signals straight! If done properly—that is, without phone calls and various guttural noises wrecking one's concentration—mass signaling allows for a leisurely, orderly ascent or descent while efficaciously tracking subjects down in either direction.

I include a rare image of Gordon and me mass-signaling together (on a different day), and the results of the 20 March 2004 effort (Figure 2). By 2004, I had this process down to an art form. We always knew roughly where every animal on our plot was after a mass signaling exercise. As a result, we knew where to drive, where to park, and where to hike in order to track the proper subjects on that particular day. There were many jeep and quad trails that we drove during the course of any

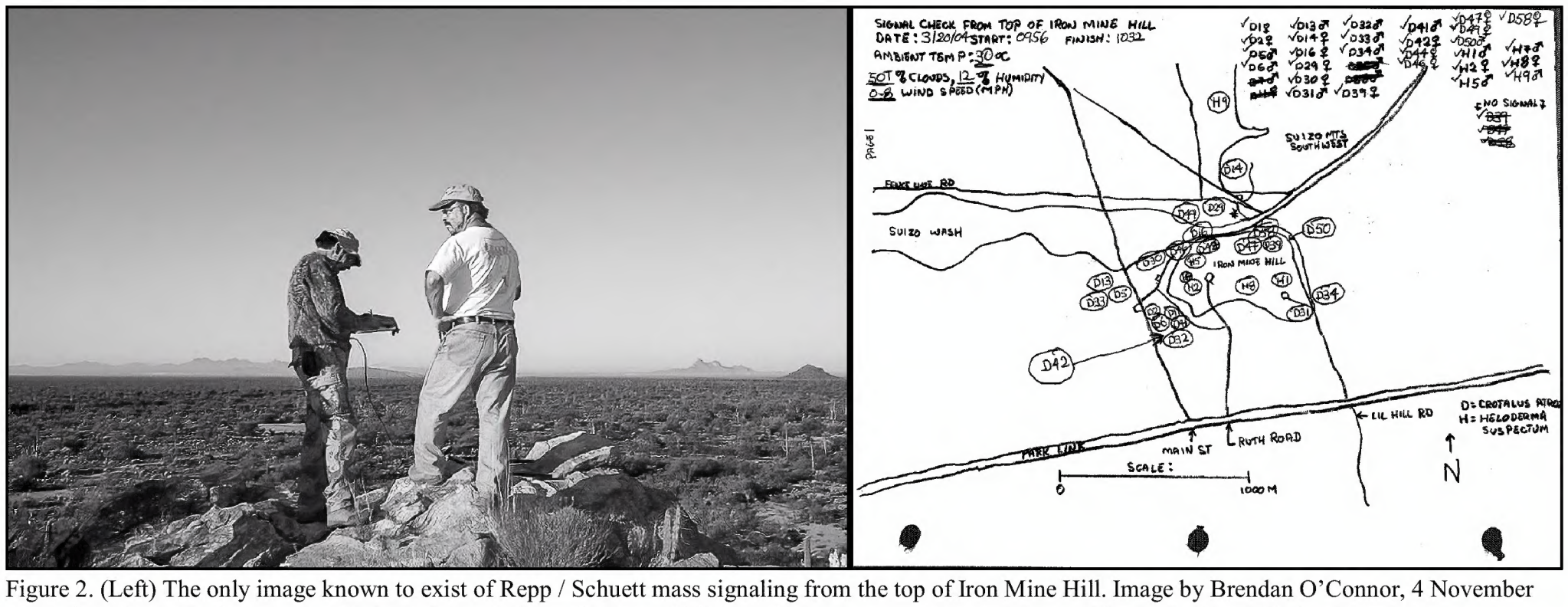

Figure 2. (Left) The only image known to exist of Repp / Schuett mass signaling from the top of Iron Mine Hill. Image by Brendan O'Connor, 4 November 2006. (Right) Crude, but highly effective! The actual results of our 20 March 2004 mass signaling exercise. At the end of this effort, we knew the rough locations of 28 radio-telemetered subjects. See text for details.

given day in order to start our hiking/tracking sessions. Without fail, crude maps like the one in Figure 2 guided us to the closest parking spot possible in order to get us close to a cluster of subjects. We move on with the original narrative:

Then:

After this pleasant interlude, we hoofed down the hill. Gordo occasionally paused to eject throat phlegm on whatever hapless prickly pear or limber bush was in his pathway. The plant parts became gaily festooned with mini-rainbows, dangling in streamers, and glittering in the sun. Our next stop was to be Marco Polo, the most wayward atrox of our plot. The plan was to catch his sorry-ass, remove the transmitter from him, and unceremoniously throw him out of our study. But nature had other plans for Marco. After driving the necessary 1.5 miles just to get close to him, we tracked him down. He was very dead, and very freshly dead. His head and about 150 mm of neck were missing. The rear 300mm of the animal was missing, and the lower half of the midsection that remained was chewed to the vertebrae, leaving some meat and skin on the ribs. The center midsection was still whole to the lower neck. Ants had just started gathering on the corpse, and there was no stench at all. I would guess this animal was killed no more than two hours prior to our arriving. I have ruled out human predation as a cause, but really am not sure what got him. You went just a little too far from home now, didn't you Marco? Maybe you should have hung a little closer to the hill? Losing an animal is always a solemn event. I asked Gordo if he would allow a prayer. Being the tolerant sort that he is, he bowed his head, and my mouth formed around the words: "Hail Mary, fair with grace. Got four balls—take first base. Amen."

Thus endeth Marco. We tossed his remains in the cooler—which was later to have unpleasant consequences with our dining experience.

Now:

I forgot the best part! Whatever predator ripped Marco asunder was kind enough to leave us the section that contained the transmitter. As a new transmitter cost three hundred sixty bucks to replace, we were much indebted to whatever choked old Marco down. If the reader is under the impression that we didn't like Marco much, my original text conveyed that message properly. As his well-earned name implies, Marco Polo was a world-traveling fool of a snake. He was a renegade outlaw of an outlier in our dataset, and every time we tracked him wrecked a little more of what we were trying to prove. Other than this *jerk* of an *atrox*, we had 100% fidelity of male *atrox* to their respective hibernacula. Before Marco, we had that 100% den fidelity, and after Marco, we had that 100% den fidelity as well. While the report never so much as hinted at what type of predator got him, I am thinking that Marco was the prey item of a coyote. We are pleased that it helped itself to Marco before he could muck things up any further. Good riddance to this blight of a hiccup and all-out anomaly in our dataset! Marco *who*? Maybe he was a figment of our imagination, or perhaps, something rotten in our Sushi? Moving on:

Then:

From there, we drove to the top of a place called "Little Hill," and got the signal for FA39. We tracked her to beneath a prickly pear, and immediately noticed that she had company. She was being courted by an unmarked male. We had forgotten to bring our processing equipment, so we decided we would get this boy the next day. (Later events were to prove that we should have stapled him to the ground.)

Now:

Yeah, on the next day (21 March), we went after FA39 again. This time, we were fully armed with processing equipment. She was still home, but her boyfriend was gone—resulting in more lost DNA for our study. Poor Peach! In his mind, all was lost if he couldn't bleed 'em.

Mention of the pairing of female #39 sent me to our highly organized 35 mm slide binder to see if I had any photos. Much to my chagrin, there were none of this pairing, and as I searched deeper for images of something—anything—from this day, I found nothing! As far as my camerawork was concerned, 20 March 2004 never happened. As I dug deeper in my slide binder, I found only a few images taken after this outing. I seem to remember backing off from taking photos of our subjects, for reasons of time and money. Those of us photographers who have been doing this for a long time tend to forget the extreme hassle of buying film, shooting our wad, taking said wad to a reputable film-developing store, paying again to have the film developed, and throwing out all but the best images – which then had to labeled properly. And on top of that, there was nothing much that could be done with an image beyond stuffing it into a slide saver sheet and filing that in the appropriate three ring binder. In September of 2005, I finally purchased a digital camera, which eliminated all need to be judicious with photographs. And the ability to email the photos to others was what revolutionized digital photography (while it vastly devaluated the worth of a good photo.)

Then:

Eventually, it was time for lunch. Sushi—with just a touch of flavoring from Marco added for good taste.

Now:

Marco *who*? The *jerk* has been dead for nearly 18 years, and he *still* permeates my thought patterns, while leaving a *bad* taste in my mouth! While sushi may seem to be atypical field fare, the supermarket across the street from my house sold a dozen rolls conveniently packaged. Five bucks got us food for a day, and the stuff was highly fortifying. We were all day long, and all day strong when we had our sushi!

We actually tracked four more *atrox* before lunch. Not a one was visible, which made for good data but poor copy for a report. Upon arriving at the shady spot for our sushi ala Marco, Gordon completely wigged out over the missing bucket. It took me all of ten seconds to shrug it off forever. But there were data in that bucket—untapped mitochondrial DNA—and the poor Peach could *not* deal with it. He kept walking up to the exact place that we had put that bucket, and kept thoroughly examining the vicinity all around that exact piece of ground. It was all a wide-open bare patch underneath a massive ironwood tree. Were the bucket within 50 feet of where we put it, we would have seen it immediately. But the Peach was having an all-out spaz

attack over his lost bucket. On at least three occasions, and maybe more, the poor Peach would turn his back on the last known bucket location, walk several paces away from it, and turn around to go back to it. It was almost as if he expected it to suddenly materialize from out of nowhere. I kept telling him "Face it Doc, it's gone. Now, try to just relax and enjoy this day, would you?" Those words were wasted. In his mind, nothing less than a total freak-out was required. Back to the narrative:

Then:

Following lunch, it was decided that the perfect adventure would be tracking down our wayward Gila MG9, "The Pilgrim." (Or should I say, "track him up.") Upon parking at the closest place to his roost, it was determined by the signal that he had moved—and was now much closer to the truck. This guess on the part of the tracker proved to be half right. He HAD moved—but certainly not closer to the truck. For every ten feet of elevation that we gained, the temp rose another degree C. The sun beat directly on the rocks we had to crawl up. The rocks were, of course, MUCH warmer than ambient, some being so hot that they burned us. I was cliffed-out twice during the ascent, and had to lose elevation to go around some formidably steep cliff faces. The Peach was dying. I kept telling him to go back down, and sit in the shade. Have a soda. Relax. But nope . . . The Peach don't drink sodies, or sit in the shade when there's work to be done.

All in all, a spunky performance by somebody who should have been mercy shot. We finally crested the last cliff face on the hill, and the signal nearly blew the speaker out of the receiver. We gained down, and immediately had him. He was in a rather open Gila hole between two knee-high slabs of "white rock." He was facing out of the hole, flush with the entrance. This was our first visual on him since we released him last September! He is in great health. Just inches of where his head resided was where we got the hot spot of the day of 52 C. Yet his body temp did not indicate that he was any warmer than most of the other animals tracked this day. My opinion is that this is the result of the solar-reflective "white rock" that can be found all over the Suizos.

Now:

Oh yes! Those "white rocks." Man could I ever go on *forever* about those! Maybe someday I will! But today is *not* that someday.

The very first animal captured for our telemetry project was a male Gila Monster (*Heloderma suspectum*). Erika Nowak was with us this day, and I'll never forget whispering to her "I'd a hundred times rather track this monster than *any atrox.*" That was in March of 2001. By March of 2004, that notion was *way* behind me. The *atrox* were infinitely more interesting to watch, and *far* less difficult to track. Good old G9, "the Pilgrim," was a good example of how a male Gila Monster can ravage the hips, knees, and backs of anybody witless enough to try to radio-track them. The reader might think a Gila Monster to be a slow and sluggish creature—and might be right in thinking that. While a foraging monster trudges along at the speed of a comfortable walk for a human, it is not their speed but their endurance and determination that carry them across vast distances. Their movement patterns are highly unpredictable with as well. Mention was made of the Pilgrim being last observed in September of 2003. After surgically-implanting the transmitter in him, and subsequent release, we lost him for several months. When we finally found him again, he was a kilometer away from his capture spot, and 80 meters in elevation higher. He had moved from the shadow of Iron Mine Hill to the upper center of the Suizo Mountains proper. He was the first of our subjects—but not the last—to take us there. Way up in the nosebleed section of our arena, Plymouth Rock and areas nearby eventually proved to be a sweet spot for three species of rattlesnakes, as well as Gila Monsters.

Our transmitters were *all* temperature-sensitive. They beeped slowly when cold, quickly when warm – all to a highly accurate gradient. By timing the speed of the signal blips with a stopwatch, we knew to an accuracy of ±0.5 °C (±0.9 °F) the core body temperature of any and all subjects we tracked during the course of any given day. Despite the fact that the shaded ambient temp was 35 °C (95 °F), and the hot-spot was 52 °C (125.6 °F) – both being the hottest temps of the day – the Pilgrim was chilling at 30.2 °C (86.4 °F) when we tracked him down. Had he slipped one body length out of his insulating shelter and into the direct sunlight, his body temp would have quickly increased – as fast as 10 °C (18 °F) per minute. But he was content to stay in his Gila hole, his snout flush with the entrance when we tracked him. We tracked 11 different animals this day. Their body temps ranged from 25.7 to 35 °C (78.3 to 95 °F), and eight of these registered warmer than the Pilgrim despite the hotter microclimate data surrounding him. The short story is that ectotherms thermoregulate, and can basically be as warm or as cold as they like on most days of the year. As an aside to what was just reported here, there was more temp data presented in this paragraph than anything else to ever emerge from our 15-year study!

I was shocked when I went after an image of the Pilgrim from this day. Gila Monsters basking with their snouts close to the entrance of their refugia were always my favorite type of *in situ* photograph to obtain. But not only was there *not* a picture of the Pilgrim from this particular day, there was not a single image of him to be found *anywhere* in my slide binder. He was in our study from September of 2003 until we pulled his transmitter and released him on 30 May 2005, and I did not have a single image of him! Things appeared to be a little lackadaisical in the photography department of the Suizo Mountain Project for sure. One doesn't often get a second chance with Gila Monsters, but on 20 August of 2007, the Pilgrim wandered into my life again. At first, I did not know who he was, and I just followed him around with my digital camera firing away. It was not until after I finished with the image-taking that I captured him and waved the microchip reader over his body. I carried a full list of all animals who had received a microchip nailed to a clipboard in my backpack, and within seconds of consulting this I knew I had the Pilgrim! Just like *that*, we gained over two years of longevity on an animal that we had all but forgotten. We also *finally* had some photos of him. I will share one here. He was a young male in 2003, but by 2007, he was entering the prime years of adulthood (Figure 3). Moving on with the narrative:

Then:

The trip back down was harder on me than Schuett. First off, I had worn shorts for two days in a row, and was badly burned. The trip up the hill had exposed the rear of my calves to direct

Figure 3. Gila Monster #9, dubbed "The Pilgrim" due to his excessive wanderings. After an absence of over two years, this traveling fool of a monster meandered back into my life. Image by the author, 20 August 2007.

sunlight for over an hour. If I so much as brushed against any plant form, I'd whine like the big sissy that I am. Then, there's the knees—which have never been a problem going up. But coming down is always a different story. (Added note: Here in Double O 7, just walking on flat ground is a chore. Good wheels are priceless in this field! And my wheels have two flats.)

Now:

At first, the reference to 2007 had me confused. I knew that I had written this report from memory two days after it happened. But that first report would have been sent to very few people. I must have sent it a second time, most likely as the "Monkey Business" part of a Tucson Herp Society meeting reminder. If there is anything else worth mentioning here, it is that I *thought* I was in pain in 2004. Comparatively speaking, I still had ten good years left in me!

Then:

Finally, the ordeal was behind us. We decided that a two-hour road cruise in blessed air conditioning would be just the ticket. We sought—and found, the great northeast passage to our plot. During the course of the cruise, we racked up some impressive Zebra Tail numbers. I was also able to watch every disease known to modern mankind pass through the body of my companion. Symptoms of diphtheria, pneumonia, HIV, tuberculosis, bronchitis, small pox, meningitis, VD, pancreatic cancer, and the common cold—with just a smattering of leprosy for good taste, were all evident in my stout-hearted comrade. We were both knee deep in damp, dank Kleenex tissues. While lounging in Germanic nasal discharge, I felt great reassurance in the good Doctor's promise that none of his symptoms were contagious.

Now:

By golly, I *did* manage to somehow stay clear of whatever fungus the Peach was carrying during the Schuett Suizo super-spreader event described above. That was the result of more luck than brains, for there was no way that he was *not* contagious this day!

There are an *amazing* number of dirt roads spread in helter-skelter fashion across the back country of most of Arizona. Many lead to cattle ponds and corrals, while others lead to old mine shafts. Some of the roads were likely created by off-roaders—quads, jeeps, 4WD monster trucks and their ilk. Topo maps from that time period were extremely misleading. The only way to know these roads was to drive them. There are two other mountain ranges to the north of the Suizos, and we were forever trying new roads to get us there and beyond. On this day, once and for all, we followed our noses through a network of roads that led us along the west side of the entire Suizo Range, hooked around the north side of them, and led us to a major highway to the east. Every inch of our route took us past some glorious herp habitat, and much like Christopher Columbus and his sea-faring Slavs, we claimed all this new turf to belong to two German-Americans. It might as well have belonged to us, as like many public lands north of Tucson, it is all there for the taking.

Mention was made of "impressive Zebra-Tail numbers." Did I accidently forget SSAR's rules of nomenclature by *not* writing "impressive Zebra-tailed Lizard (*Callisaurus draconoides*) numbers" in my report? Nope, that was deliberate! On a normal March Day, we wouldn't see any. But on this very hot March afternoon, we encountered 42 of them. On the best of days in April or May, I used to consider 25 to be above average. But ever since the drought of 2020, any number more than five is *excellent*! Thankfully, 2021 brought us the wettest year since 1992. Common lizards are *always* quick to rebound after such events, and I can look forward to an explosion of lizard activity by late spring of 2022.

Then:

Following the road cruise/snot-a-thon, we tracked down FA2, "Dianna." She has cleared out of her winter site, and was found crawling toward Main Street, about 50 meters west of her winter home. She retreated into some prickly pear, and we got a good enough look at her rattles to determine that she has shed since giving birth to five kids this summer. She is in great health.

Now:

There is a long story that could be told about each of our study *atrox*. Every one of them was a performer on one of the world's most fantastic stages. *Atrox* are without question the most common snake in most of Southern Arizona. And radio-tracking revealed that they are also a highly-visible species with *all* aspects of their lives. When one was tracking them, most everything they did was above ground for us to see. They are not a secretive species, and yes, tracking them *did* allow us to witness the drama of nature in such a way that each snake we tracked did indeed appear as an actor playing its part in the bigger picture of life. And Dianna's performance through the five or so years that we followed her was above and beyond most of the others, and *certainly* the best of our early years of the study. She was the second *atrox* to enter the study, and the youngest of the three females to be captured at AD1. Going *way* out on a limb, all evidence points to her entering AD1 as a maiden. Given more time, we could minimally reveal that she came to AD1 with one purpose in mind, and that purpose was to mate. The year 2000 was the third consecutive wet year around Tucson, and 2001 began as a continuation of that wet cycle.

Figure 4. (Left) Three separate "plot biscuits" were observed distorting the flanks of *Crotalus atrox* #2, "Dianna," on 17 May 2001. After years of guesswork, the author is fairly certain that the prey items are young rabbits. (Right) By 5 July 2001, Dianna's feast was digested and converted to useful snake mass. She gave birth shortly after this photo was taken. For a quick look at Dianna taken nearly two weeks before she became one of our subjects, see also the left-hand image of Figure 1.

While we have no way of knowing what she did before March of 2001, we *do* know much about what she did for five years after. In the left-hand image of Figure 1, the *atrox* on the left is Dianna. Her rattle count is basal plus eight segments, the last being the button. That image was taken on 9 March 2001. We did not actually capture her until 22 March 2001. On that day, she was completely hidden by a larger male who had coiled on top of her. A thorough processing revealed that her rattle count was exactly the same basal plus eight as in Figure 1. There are also dozens of photos of Dianna taken post-processing that clearly revealed that she *was* that same snake as in Figure 1.

Eyeballs are going to roll with what I say in this upcoming paragraph. So I might as well enter it with guns blazing. First of all, there is *nobody* on this planet who knows more about the natural history aspects of *Crotalus atrox* in all of Arizona then me. That last statement is especially true about the *atrox* on our study plot. There are massive piles of data that *might* some day prove everything that I say next. I don't ask that you believe me, I only ask that you follow and understand what it is that I am saying. There were three female *atrox* from AD1 processed in March 2001. The other two were mature females. We might even call them "old ladies." Both were roughly 100 mm (~4 inches) longer, with rattle strings that were straight and with broken segments. The fact that Dianna had a tapered and complete string of rattles indicates her to be a younger snake. Despite the fact that she was 100 mm shorter, her mass (weight) was nearly identical. In other words, she was healthy and had a hefty build. Having studied the rattles of hundreds of *atrox* gives me a *bunch* of age-related data to work with when it comes to discussions of a young snake like Dianna. Everything I see tells me that she was born in August of 1998, which was a time of plenty in her birth place. She probably shed twice, and likely hibernated out in the flats. The following year, 1999, was another banner year. My records indicate fantastic numbers of snakes and lizards. She probably ate like a pig, and shed three times. Hence, when she entered hibernation in November of 1999, she had a rattle count of six complete segments. She was still living in the flats, and when she emerged from hibernation in March of 2000, she was still not quite sexually mature. Maybe she mated; maybe she didn't. I would say not. The year 2000 was another wet year, but not as good as what 2001 brought us. In any case, I am saying she shed twice in 2000, and hibernated in the flats again. When she ingressed from her hibernaculum in early March of 2001, she was a prime candidate for mating. But where were the males? They were *all* in aggregate dens. All she had to do was sniff out the closest of these dens. In her case, that was AD1. Hence, by her capture date of 22 March 2001, she was carrying the sperm of several different males. But she was *not* pregnant yet. She had yet to ovulate. She first had to generate enough fat reserves to complete the fertilization process. At this point in the narrative, we either launch into several thousand more words, or we just show you two images that demonstrate that nature gave her *everything* she needed to become the first female to undergo parturition in the Suizo Mountain Project. We will tell the whole story of Dianna someday, but it is now time to wrap up 20 March 2004. See Figure 4.

Then:

Next was MA13, AKA "Lucifer." He was found clean out in the center of his summer range, looking like the most awesome D'back that he is. He was on the prowl when discovered. He also gave us a good rattling show, which seldom happens with any of our animals. Getting back to the summer range thing—he is now about 500 meters from den AD4. In normal years, he'd still be there. So, at this point in time, we have four female atrox at or within 20 meters of their hibernaculum. The remaining female atrox have all made small moves from their dens. All male atrox have left the dens WAY behind, and could be anywhere. Every Gila has moved, but like their atrox counterparts, could be anywhere on any given day.

Now:

The word "hibernaculum" in the text of the original report should have been "hibernacula." I am stubbornly refusing to change any words of my 2004 report, so we do so here. Briefly, Latin is a language of endings. Hibernaculum is the singular form of an overwintering den, and hibernacula indicates a plural

form. The usage of the word "hibernaculum" is arguably correct as used—but our editor has ordained me to be wrong. And *he* is the word boss of this show!

Then:

One last tidbit before ending this epic report. As mentioned earlier, atrox were encountered on the road out. The first was a big male on Park Link Road. We bagged him, took the necessary data, and then the driver decided to take a leak. As far as whizzes go, it was better than average. Everything was then packed up, (we speak of collecting equipment), and we pulled away from the capture spot. Immediately, a cop car rounded the bend coming from the opposite direction. I had been less than one minute away from perhaps entertaining a quizzical cop whilst handling a favored body part.

COPS! Cops on MY back roads. I have truly lived too long.

This here is Roger Repp, signing off from Southern Arizona, where the turtles are strong, the snakes are handsome, and the lizards are WAY above average.

Epilogue

I just went on a two-hour-long search trying to ascertain when I first started using my Garrison Keillor / Lake Wobegon rip-off as my own signature sign-off. I first searched for *his* words, which are: "Welcome to Lake Wobegon, where all the women are strong, all the men are good-looking, and all the children are above average." On the very page that I found his famous words is an advertisement for the new HBO Max series entitled *The Sex Lives of College Girls*. Yehaw! Hopeful that *my* rip-off was getting that kind of attention, I did a search for my sign-off. Nope! Nothing but herp stuff to be had. The bottom line is that I have *no idea* when I first started using the sign-off. It was likely at some point between 2001 and the time that this missive went out in 2004. Summing it up, with this report, I am very close to the origin of the sign off. And I want to know why the *hell* EYE don't rate an ad hawking sordid TV shows centering on smut and college girls? I will launch a formal complaint to our editor about this.

I have created a very brief Literature Cited section for this column. It was done in order to address some of the history behind what has been written here about the Suizo study. This was mainly done to satisfy my own curiosity, but I include it for any newer members, or even old friends who wish to go back. I also kept any lit cited to a bare minimum. As suggested above, if I included *everything* that mentions the Suizo Mountain Project, I'd probably have at least 20 citations, and several books and book chapters to include.

The three references below are perfect for the early phases of our 15-year radio-telemetry project. Repp (2015) describes my first visit to Iron Mine Hill. Repp (2017) deals with an observation on female *atrox* #2. She plays a somewhat prominent role in both this column and that one. Repp (2020) describes the origins of the Schuett / Repp team.

The reader can find any and all of these articles, as well as many other fantastic articles from past *Bulletins* online at: http://chicagoherp.org/bulletins-2.

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Herpetology 2022

In this column the editorial staff presents short abstracts of herpetological articles we have found of interest. This is not an attempt to summarize all of the research papers being published; it is an attempt to increase the reader's awareness of what herpetologists have been doing and publishing. The editor assumes full responsibility for any errors or misleading statements.

SOCIAL BEHAVIORS IN MARINE TURTLES

A. R. Gaos et al. [2021, Chelonian Conservation and Biology 20(2):167-172] note that social behaviors represent a central tenet of ecology and evolutionary biology, but remain widely undocumented in reptiles. Although marine turtles have been studied for decades, the prevalence, importance, and potential role of social behaviors have been largely overlooked. Consequently, marine turtles have predominantly been characterized as nonsocial animals in the literature. The authors report on visual observations of hawksbill turtles (*Eretmochelys imbricata*) inhabiting a nearshore coral reef in Hawai'i that reveal a complex array of social behaviors. Combined with recent evidence for social behaviors in other marine turtle species, these results confirm that traditional views of nonsocial life histories are incomplete and that social behaviors are likely prevalent in many marine turtle species. This study has important implications for marine turtle management and suggests that increased research into social behaviors is warranted across the taxon.

ECOLOGY OF A HOT SPRINGS ENDEMIC TOAD

B. J. Halstead et al. [2021, Herpetologica 77(1):24-36] note that desert amphibians are limited to exploiting ephemeral resources and aestivating or to inhabiting scarce refuges of permanent water, such as springs. Understanding how amphibians use these resources is essential for their conservation. Dixie Valley toads (*Anaxyrus williamsi*) are precinctive to a small system of cold and hot springs in the Dixie Valley, Nevada, USA. The toads have been petitioned for listing under the US Endangered Species Act, and information about how they use terrestrial and aquatic resources will help managers to conserve the toads and identify threats like geothermal energy development that might affect these toads. The authors used radiotelemetry to study the seasonal home ranges, movements, and habitat associations of Dixie Valley toads in autumn 2018 and spring 2019. They found that toads were very closely associated with water in both seasons, with most observations occurring in water, especially for males in spring and all toads in the autumn. Even when found in terrestrial habitat, toads were a median distance of 4.2 m (95% credible interval = 3.3–5.3) from water; 95% of the time in spring and autumn, toads were within 14 m of water. Dixie Valley toad habitat selection indicated a similar pattern, with selection in both spring and autumn for locations closer to water and for warmer water and substrates than at nearby available locations. In autumn, toads also avoided bare ground and terrestrial graminoids. Dixie Valley toads selected brumation sites in, over (within dense vegetation), or near water, often near springs where water depths and temperatures are likely stable through the winter. The reliance of Dixie Valley toads on water in spring, autumn, and during brumation suggests that alteration to historical flows and water temperatures are likely to affect the toads. Changes to the hydrothermal environment when toads are brumating could be particularly detrimental, potentially killing inactive toads.

HUMAN IMPACTS ON DESERT TORTOISES

K. H. Berry et al. [2020, Herpetologica 76(1):1-11] evaluated the status of a population of Mojave desert tortoises (*Gopherus agassizii*), a threatened species, in the El Paso Mountains of the northwestern Mojave Desert in California. The study area lies north of and adjacent to a designated critical habitat unit for the species, is adjacent to a state park, and is a short distance from the Desert Tortoise Research Natural Area. The authors randomly sampled 373 1-ha plots from a 239.1-km^2 area in the mountain range to determine demographic attributes of the population, vegetation associations, predator presence, and human uses. Live and dead *G. agassizii* and sign (burrows, scats, tracks) occurred on 35.7% of plots. Densities of adults were higher than in adjacent critical habitat, and threats (traumatic injuries, infectious and other diseases) were similar to those reported elsewhere. Signs of human use were evident on 98.4% of plots. Vegetation, predators, trash, mining activity, and vehicles were important factors affecting the distribution and intensity of tortoise sign. The authors concluded that this population is in a downward trend, like other populations in the western Mojave Desert. The high death rate of adults, low population density, high human visitor use, and ongoing decline in the adjacent critical habitat unit indicate that a viable population is unlikely to persist in the study area. The future for the population found in the El Paso Mountains might depend on survival in the adjacent roadless El Paso Mountains Wilderness Area.

THE ROLE OF NATURAL HISTORY COLLECTIONS

E. J. Hilton et al. [2021, Ichthyology and Herpetology 109(2): 379-391] note that museum specimens serve as the bedrock of systematic and taxonomic research and provide the basis for repeatability or reinterpretation of preserved aspects of phenotypes. Specimens are also fundamental to fields such as ecology, behavior, and development. Each specimen is a record of biodiversity and documents a particular species present at a particular place at a particular time. As such, specimens can provide key evidence for biodiversity and conservation initiatives. Four aspects of natural history collections and their use are discussed: 1) collection, curation, and use of specimens, particularly non-traditional specimens; 2) the use of specimens and technological advances in morphology, ontogeny, systematics, and taxonomy; 3) specimen use in other fields of biology and ecology; and 4) specimen use in education and outreach. Collections, and their vitality, depend on both their continued roles in traditionally supported fields (e.g., taxonomy) as well as emerging arenas (e.g., epidemiology). Just as a library that ceases buying books becomes obsolete, or at least has diminished relevance, a natural history collection that does not continue to grow by adding new specimens ultimately will limit its utility. The authors discuss the roles of specimens and speak directly to the need to increase the visibility of the inherent value of natural history collections and the care of the specimens they protect for future generations.

DIETS OF SPECKLED RATTLESNAKES

C. Cochran et al. [2021, Journal of Herpetology 55(1):77-87] note that dietary studies are central to our understanding of organismal biology. They describe the diet and frequency of feeding in the southwestern speckled rattlesnake (*Crotalus pyrrhus*). They used data from wild-caught specimens collected from six biogeographic regions (pooled to three regions for analysis) across the species' range in the United States that include Arizona, California, and Nevada, USA. Fecal material from 185 snakes yielded 104 prey items from 72 individuals, and palpation indicated recent meal ingestion in 36 of 174 individuals. The diet consisted predominantly of mammals (80.8%), in particular terrestrial squirrels (39.4%) and members of the heteromyid rodent genus *Chaetodipus* (26.9%). Male and female snakes exhibited similar diets and feeding frequency, but an ontogenetic shift occurred from primarily ectothermic (lizards) to endothermic prey (rodents and birds) and more frequent feeding. Consumption of ectotherms vs. endotherms appeared to be similar among biogeographic regions, but snakes from the Tinajas Altas Mountains, Arizona, preyed disproportionately on birds compared with other regions, and snakes from the Sonoran Desert-Arizona Upland region more frequently ingested recent meals than those from the California-Nevada region. Regardless of sex, size, and biogeographic region, snakes consumed fewer prey during the spring breeding season than during summer and autumn. This study provides data on the diet of *C. pyrrhus* for testing further hypotheses regarding interspecific competition, dietary changes associated with climate change, foraging tactics associated with bird predation, competing behaviors during breeding season, and venom composition variation.

BROMELIAD SAMPLING

Y. Aguilar-Cruz et al. [2021, Ichthyology and Herpetology 109(1): 211-218] note that bromeliads are recognized as vital habitats for arboreal amphibians. However, these plants are often not included in traditional amphibian surveys. Furthermore, focused canopy sampling techniques are time-consuming, require specialized equipment and training, and, in the case of bromeliads, sampling is typically destructive. The authors developed and tested a passive sampling technique for amphibians in bromeliads, which can be easily implemented in common amphibian surveys in the Neotropics. The study was conducted in five different forests along an elevation gradient (0–2,200 m a.s.l.) in the central region of Veracruz, Mexico. In each forest, 15 tank bromeliads were relocated on trees at 1.5 m above the ground (n = 75) by fastening them onto metal rings attached to the trees. Over a one-year period, these bromeliads were inspected monthly for amphibians. A total of 34 individuals belonging to eight species were recorded, including small and rare species that are normally difficult to find in the field. This technique appears to be effective in detecting frogs and salamanders across a range of ecosystems, especially in the cloud and mangrove forest where they were found more frequently throughout the year. Bromeliad relocation represents an alternative sampling technique for arboreal amphibians, which reduces the number of bromeliads that have to be sacrificed, requires few resources and minimal prior knowledge, and can be implemented effectively in studies that need repeated sampling through time.

RATSNAKES IN THE FUKUSHIMA EXCLUSION ZONE

H. C. Gerke et al. [2021, Ichthyology and Herpetology 109(2): 545-556] note that the 2011 nuclear accident in Fukushima, Japan, was one of the largest anthropogenic releases of radioactive contamination in history, and many questions remain regarding its ecological impacts. As part of a larger study estimating animal movements and radiation exposure within the impacted area, the authors used a combination of VHF and GPS transmitters to estimate home range size and habitat use of nine Japanese ratsnakes (*Elaphe climacophora* and *E. quadrivirgata*) over three months within the Fukushima Exclusion Zone. Short-term a-LoCoH ranges varied from 0.15 to 6.80 ha, and daily movements ranged from 30 to 116 m. Short-term home ranges included more areas close to streams, buildings, and roads, as well as more grassland and less evergreen forest than expected given the availability of these habitat components on the landscape. Within their home ranges, snakes selected areas close to streams and avoided evergreen broadleaf forests. They also frequently used habitat features such as trees and buildings, although use of buildings was highly variable among individuals. The limited distance snakes moved compared to more mobile species suggests snakes could be useful bioindicators of local contamination. However, radionuclide exposure will still vary considerably among individual snakes within localized areas due to differences in habitat use.

HEAD-STARTING GOPHER TORTOISES

T. D. Tuberville et al. [2021, Journal of Herpetology 55(1):88-94] note that gopher tortoise (*Gopherus polyphemus*) populations are declining throughout the southeastern United States. Range-wide conservation efforts include identifying populations that do not currently meet viability criteria but are suitable candidates for population enhancement. The authors investigated the potential role of head-starting as a recovery tool by releasing hatchling and head-started yearling gopher tortoises as pairs (n = 28) into adult burrows in fall and comparing their movements and survival until winter dormancy. Head-started yearlings experienced higher predicted survival than did hatchlings (87.7% vs. 56.5%). Head-started individuals also tended to move greater distances between burrows and established dormancy burrows further from their release burrows, but the differences were not significant. Most individuals of both groups used a small number of closely spaced burrows, although hatchlings took longer than head-started individuals to establish their first burrow (11.3 vs. 4.4 d on average) and a higher proportion were depredated or censored before establishing a burrow (35.7% vs. 10.7%). The paired release design provides strong experimental evidence that head-started yearling gopher tortoises experience at least a short-term survival advantage over hatchlings, while exhibiting comparable fidelity to the release site. Soft-release pens were not necessary to promote high site fidelity in this study, but the decision as to whether or not to use them at other release sites may be dictated by the predator community and what is practical to implement. The authors contend that head-starting shows promise as a recovery tool for gopher tortoises and that hard releases may be a worthwhile option for managers to consider.

A Message from the CHS President

If you haven't read it yet, please take a look at our annual financial report for 2021 on the facing page. Even if you're not a numbers person, you can see that your society is not in great financial shape. That is because for the last two years, we haven't held ReptileFest. And we won't be holding it this year either. While we keep our overhead to a minimum, we do have fixed costs involved in our operation, mainly producing and mailing this *Bulletin*, insurance and storage rental. Of course, all of the board members and the members performing our programs are volunteers.

Since 1966 the Chicago Herpetological Society has published more than 450 *Bulletin*s. And while not peer-reviewed, the *Bulletin* has included articles and papers that have been referenced in dozens of scientific studies. Your society has awarded over $150,000 in grants involving herpetological research, conservation and field studies. We have re-homed and healed hundreds of animals that would probably have been euthanized or simply starved to death without our adoption program. We have educated thousands of people about herps while doing shows for institutions as diverse as planetariums, museums, libraries, and schools, most totally free of charge. Prior to 2020 our two-day event, ReptileFest, drew an average of 6,000 people who learned about these animals through the hard work of hundreds of volunteers displaying hundreds of their animals, many very rare, in an event that fills 40,000 square feet of space and entertains both the attendees and the presenters. We support and sometimes educate local animal control in the unique handling that reptiles and amphibians require. At our monthly meetings we would bring world class speakers to talk about research, husbandry, and sometimes the anecdotes of field trips that members and guests had experienced.

We're in a bad time, and I know you've been hearing that from many directions lately. With all herp societies gradually declining in membership, Covid may be driving us totally out of business. Perhaps our time has come and gone, but I don't really believe that all of the value described in the preceding paragraph should be allowed to dissolve. We're not going to shame anyone into supporting or joining the CHS. I don't think that would work. We want to be valuable to you. We want your twenty-five dollars (a real bargain!) to be spent on something you think is worthwhile. But we don't know everything, so in the next couple of months we'll be emailing a survey asking for your suggestions and desires. Please take a few minutes to think about what we can do to make your society valuable to you. Or you can always just email me with your thoughts and suggestions.

And if you can, we could really use your donation (there's a "Donate" button at www.chicagoherp.org).

Thank you,

John Archer
President
jarcher@chicagoherp.org

Chicago Herpetological Society
Income Statement: January 1 -- December 31, 2021

Income		Expense	
Membership dues	$ 9,103.80	Bulletin printing / mailing	17,877.00
Donations	5,577.87	Membership related	151.00
AmazonSmile	96.86	Grants and donations	3,500.00
Interest	1.99	Rent (storage)	2,115.00
Miscellaneous	250.00	Bank / PayPal / Square fees	546.48
		Liability insurance	1,261.00
		Dues, licenses and permits	815.99
		Miscellaneous supplies	17.24
		Shows	10.16
		Postage	2,013.05
		General meeting expense	599.39
		Library	72.00
		Adoptions	1200.00
Total Income	$15,030.52	Total Expense	$30,178.31

Net Income ($15,147.79)

Chicago Herpetological Society
Balance Sheet: December 31, 2021

Assets	
Checking	$ 3,216.19
Money market	11,477.15
Petty cash--show fund	350.00
PayPal	1,941.37
Postage on deposit	269.49
Total Assets	$17,254.20
Equity	
Retained earnings	32,401.99
Net income	(15,467.81)
Total Equity	$17,254.20

Minutes of the CHS Board Meeting, December 17, 2021

A virtual meeting of the CHS board of directors via Zoom conference video/call was called to order at 7:35 P.M. Board members Rich Crowley, Stephanie Dochterman and John Gutierrez were absent. No nonmembers of the board were in attendance. Minutes of the November 12 board meeting were read and accepted with changes.

Officers' reports

Treasurer: The November financial report was reviewed.

Membership secretary: Mike Dloogatch read the list of those whose memberships have expired.

New business

The board discussed the pros and cons of holding an in-person holiday meeting on December 29. This was thought to be a bad idea because of the latest developments with the pandemic. With not enough time to put together a virtual meeting, the December 29 meeting was canceled. It was suggested that the January meeting might take the form of a virtual party.

John Archer suggested sending out a letter to all members letting them know what is happening in the society, including an appeal for donations, and asking what they would like to see and do in the upcoming year.

The meeting adjourned at 8:20 P.M.

Respectfully submitted by recording secretary Gail Oomens

NEW CHS MEMBERS THIS MONTH

Kaleb Banks
Evan Flint
Jason Hood
Christopher Jones
Lara Sviatko

Advertisements

For sale: **highest quality frozen rodents**. I have been raising rodents for over 30 years and can supply you with the highest quality mice available in the U.S. These are always exceptionally clean and healthy with no urine odor or mixed in bedding. I feed these to my own reptile collection exclusively and so make sure they are the best available. All rodents are produced from my personal breeding colony and are fed exceptional high protein, low fat rodent diets; no dog food is ever used. Additionally, all mice are flash frozen and are separate in the bag, not frozen together. I also have ultra low shipping prices to most areas of the U.S. and can beat others shipping prices considerably. I specialize in the smaller mice sizes and currently have the following four sizes available: Small pink mice (1 day old—1 gm) , $25 /100; Large pink mice (4 to 5 days old—2 to 3 gm), $27.50 /100; Small fuzzy mice (7 to 8 days old—5 to 6 gm), $30/100; Large fuzzy mice / hoppers (10 to 12 days old—8 to 10 gm), $35/100 Contact Kelly Haller at 785-224-7291 or by e-mail at kelhal56@hotmail.com

Line ads in this publication are run free for CHS members—$2 per line for nonmembers. Any ad may be refused at the discretion of the Editor. Submit ads to mdloogatch@chicagoherp.org.

UPCOMING MEETINGS

After an all-too-brief flirtation with in-person meetings, the Chicago Herpetological Society will once again be holding monthly general meetings online via Zoom. A notification will be sent by email to all members who have supplied us with an email address. As has been our custom for over 50 years, the meetings will be held on the last Wednesday evening of each month. The January meeting is scheduled for Wednesday, January 26, at 7:30 P.M. Chicago time.

This month we'll celebrate a new year with a virtual party. We can't be in-person but this will be fully participatory, including your photos, your animals, your art, and your stories. You're going to have fun because you're part of the event!

****CHS Virtual New Year's Party****

Join us for a new type of CHS party January 26, 7:30 – 9:00 P.M. on Zoom! We hope to include the following activities:

Show & Tell / Herp Story Slam
Do you want to show off your reptile or amphibian to the society and share facts about them? If you don't have a herp or would rather share a story, tell us your best field herping story or interaction with herps in nature! Limited spots are available. To participate please email our CHS VP Rachel Bladow (rbladow@chicagoherp.org).

Photo and Art contest
Submit your own original herp photography or original art before the meeting. We will view and vote on the images in the meeting, and the winning images will be featured in the CHS *Bulletin*! Please submit your original photos and/or art to VP Rachel Bladow (rbladow@chicagoherp.org)

Trivia
Think you know everything there is to know about herps? Attendees will join break-out rooms to work together and test their knowledge to compete to be the winning team!

Invite your friends!

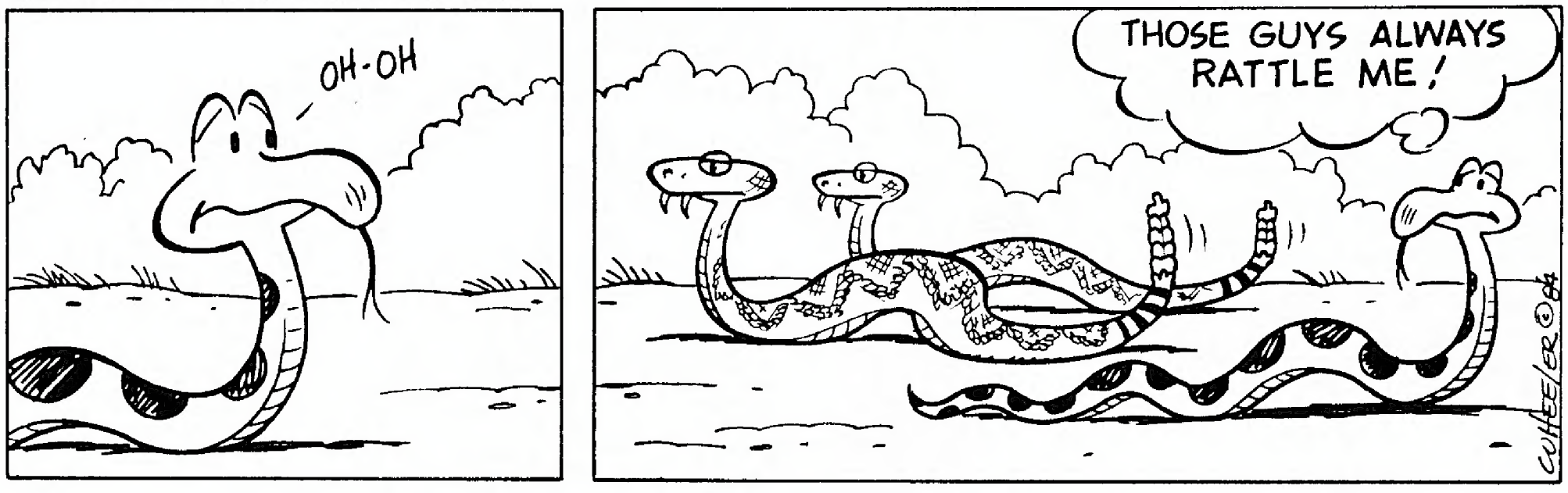
A program for the February 23 meeting has not yet been confirmed.

Please check the CHS website or Facebook page each month for information on the program. Information about attending a Zoom webinar can be found here:
<https://support.zoom.us/hc/en-us/articles/115004954946-Joining-and-participating-in-a-webinar-attendee->

Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? The next board meeting will be held online. If you wish to take part, please email: mdloogatch@chicagoherp.org.

THE ADVENTURES OF SPOT



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